

REMARKS

This application has been carefully reviewed in light of the Examiner's Action dated December 12, 2007. Claims 1 and 64 have been amended. Reconsideration and full allowance are respectfully requested.

The Examiner rejected Claim 64 under 35 U.S.C. § 102(b) as being unpatentable over U.S. Patent No. 3,963,347 by Segre, et al ("Segre"). This rejection is respectfully traversed for the reasons set forth below.

As presented, Independent Claim 64 is directed to a method for analyzing atmospheric aerosols that involves transmitting a beam with a high pulse energy and efficiently collecting backscattered radiation. Specifically, the method involves transmitting a beam into the atmosphere and receiving backscatter radiation of the beam. The beam has a wavelength between about 1.5 – 1.8 microns and a pulse energy of at least about 100 mJ/pulse. Moreover, the field of view of the receiver is at least about equal to the divergence of the transmitted beam, and the range resolution is no more than about 50 meters. Accordingly, the Claim sets forth limitations related to wavelength, optical efficiency, range resolution, and pulse energy. As set forth above, the method of the present invention enables detection of atmospheric aerosols, which is a particularly challenging lidar application and, specifically, allows for imaging of aerosol structures such as by scanning of the lidar beam.

Imaging of aerosol plumes is a particularly challenging lidar application. First, unlike detecting clouds or precipitation, the aerosol structures of interest are difficult to detect, and it is desired to detect such aerosol particles even when they are present only in low concentrations. For example, one application of the invention is to detect biological agents in the atmosphere. Accordingly, it is desirable to transmit a beam of significant energy and/or to detect even low levels of backscattered radiation. Moreover, unlike detecting cloud ceiling levels, in various applications supported by the claimed invention including aerosol detection/evaluation, it is desirable to image a significant volume of the atmosphere (e.g., around a protected facility or battlefield) by scanning the lidar beam across the volume to be imaged. In order to obtain meaningful information, the scan should be completed in a reasonably short period of time in relation to anticipated rates of movement of the aerosols in the atmosphere.

It will thus be appreciated that significant energy is transmitted into the atmosphere and detected in such contexts to collect adequate backscattered radiation and that such energy levels are

transmitted in short time frames (i.e., a single pulse or small number of pulses at a suitable pulse repetition frequency) to enable scanning rates for effective imaging. That is, high levels of both spatial and temporal resolution are desired. Yet, this is preferably accomplished at eye safe levels to avoid harming pilots, passengers, building occupants and the like. Corresponding subject matter is set forth in Independent Claim 64, which recites limitations related to wavelength, optical efficiency, range resolution, and pulse energy.

The Examiner rejected Claim 64 as being anticipated by U.S. Patent No. 3,963,347 by Segre, et al (“Segre”), which is directed to a ceilometer. The Segre ceilometer application does not involve imaging of aerosol plumes, much less levels of spatial and temporal resolution as discussed above. It is therefore unsurprising that Segre does not disclose or suggest the subject matter of Claim 64 as presented. For example, Segre, which is not concerned with scanning for producing an image of aerosol plumes, does not disclose a suitable combination of wavelength, optical efficiency, pulse energy, and range resolution.

Further, Applicant maintains that Segre does not disclose or suggest an optical beam having a pulse energy of about 100 mJ/pulse. Rather, the parameter cited by the Examiner is not 100 mJ/pulse, but is an intensity parameter. Applicant submits that the cited portion of Segre relates to intensity, said to be measured in energy (joules) per area (cm^2), and does not indicate any time dimension, e.g., per pulse as claimed. Accordingly, Segre, even in the context of background discussion, does not discuss a 100 mJ/pulse parameter.

Additionally, Segre does not disclose a receiver having a range resolution of no more than about 50 meters. The range resolution of a receiver may be dependent upon several factors that often involve design tradeoffs to suit a particular application. These factors include: pulse duration of the transmitted beam, response of the detector surface, the response of amplifiers, the digital sampling rate, and other factors. It is therefore not surprising that Segre does not disclose a receiver having a range resolution of no more than about 50 meters as Segre is directed to a ceilometer, rather than a lidar system that may be used to detect aerosol plumes, which requires relatively higher levels of spatial resolution.

For all of the foregoing reasons, Applicant respectfully submits that Segre does not disclose the claimed subject matter including the noted limitations related to wavelength, optical efficiency, range resolution, and pulse energy. Accordingly, Applicant submits that Independent Claim 64 is patentable over Segre and this rejection should be withdrawn.

The Examiner rejected Claims 1, 17-18, and 67-68 under 35 U.S.C. § 103(a) as being unpatentable over Segre in view of U.S. Patent No. 6,580,732 by Guch, Jr. et al (“Guch”). This rejection is respectfully traversed for the reasons set forth below.

As presented, Independent Claim 1 is directed to an optically efficient, high pulse energy lidar system. In particular, the lidar system has a receiver field of view at least as great as the divergence of the laser beam and a range resolution that is no more than about 50 meters. This provides both enhanced optical efficiency as the receiver can “see” substantially the full volume of atmosphere illuminated by the source in the coaxial transmit/receiver system geometry, and a range resolution that is desirable for detecting and subsequently imaging aerosol plumes. Moreover, the transmitted beam has a pulse repetition frequency of at least about 10 Hz and a pulse energy of at least about 100 mJ/pulse. This supports certain applications including imaging of aerosol plumes or other aerosol structure in the atmosphere.

As discussed above, Segre is directed to a system for measuring a cloud ceiling. Segre is not concerned with imaging of aerosol or other structures in the atmosphere and does not disclose operation suitable for scanning the atmosphere to produce such images. As discussed above, Segre does not disclose the 100 mJ/pulse parameter. Further Segre does not disclose a receiver that has a range resolution that is no more than about 50 meters.

Guch is cited as disclosing a beam that has a pulse repetition frequency of at least about 10 Hz. Guch is directed to a multiple mode, solid-state laser, rather than a transmitter for a lidar system claimed in Claim 1. Assuming arguendo that the combination of Segre and Guch is proper, Guch does not supply the subject matter lacked by Segre. Applicant therefore respectfully submits that Independent Claim 1 and its dependent claims are patentable over the combination of Segre and Guch and this rejection should be withdrawn.

The Examiner rejected Claims 13-15 under 35 U.S.C. § 103(a) as being unpatentable over Segre in further view of Guch in further view of U.S. Pat. Pub. 2003/0016350 by Cheng, et al (“Cheng”). As discussed above, Claim 1 includes a transmitter for transmitting an optical beam having a pulse repetition frequency of at least about 10 Hz and a pulse energy of at least about 100 mJ/pulse. Claim 1 also includes a receiver having a range resolution of no more than about 50 meters. Segre and Guch do not disclose the subject matter of Claim 1 for the reasons noted above. Cheng does not supply the subject matter lacked by Segre and Guch. In particular, Cheng is directed to a micropulse lidar system. It involves lidar beams with pulses in the microjoule energy range. Accordingly, the

proposed combination of Segre, Guch, and Cheng does not disclose or suggest the subject matter of Independent Claim 1. Moreover, Cheng specifically teaches away from higher energy pulses due to safety concerns. Thus, Applicant respectfully submits that the proposed combination is improper. For all the foregoing reasons, Applicant respectfully submits that this rejection should be withdrawn.

Claim 16 was rejected under 35 U.S.C. § 103 as being unpatentable over Segre in view of Guch in further view of Cheng in further view of the publication by Kurnit, et al (“Kurnit”). Kurnit was cited as disclosing an InGaAs detector. Kurnit does not otherwise disclose or suggest the subject matter of Independent Claim 1 lacked by the proposed combination of Segre, Guch, and Cheng, as discussed above. Applicant therefore respectfully submits that Claim 16 is patentable as depending from a patentable base claim.

Claims 2-3, 8-9, 11-12 and 23 were rejected under 35 U.S.C. 103(a) as being unpatentable over Segre in view of Guch in further view of Kurnit. In this regard, the Examiner cites Kurnit as disclosing various technology related to a Raman shifter, a beam compressor, a beam expander and a beam filter. As noted above, Segre and Guch do not disclose the subject matter of Independent Claim 1, and Kurnit does not provide the disclosure lacked by Segre and Guch in this regard. Applicant therefore respectfully submits that the noted Claims are patentable over the proposed combination of Segre, Guch, and Kurnit. In any event, Applicant respectfully submits that the proposed combination is improper, for example, because it is unclear why the source system of Kurnit would be desirable in the ceilometer application of Segre, and the multiple mode laser application of Guch. For all of the foregoing reasons, Applicant respectfully submits that this rejection should be withdrawn.

The Examiner rejected Claim 4 under 35 U.S.C. § 103(a) as being unpatentable over Segre in view of Guch in further view of Kurnit in further in view of U.S. Patent No. 5,058,117 Shoshan, et al (“Shoshan”). Shoshan is cited as disclosing a Raman shifter including at least one internal reflectance element. Shoshan does not otherwise disclose the subject matter of Independent Claim 1 lacked by the proposed combination of Segre, Guch and Kurnit. Accordingly, even assuming arguendo that the new combination proposed by the Examiner is proper, the proposed combination does not yield the subject matter of Claim 4, and this rejection should therefore be withdrawn.

Claim 5 was rejected under 35 U.S.C. § 103 as being unpatentable over Segre in view of Guch in further view of Kurnit in further view of U.S. Pat. No. 4,095,121 by Begley, et al (“Begley”). As discussed above, Independent Claim 1 is patentable over the proposed combination

of Segre, Guch, and Kurnit, and Claim 5 is therefore allowable as depending from an allowable base claim.

Claims 6 and 7 were rejected under 35 U.S.C. § 103 as being unpatentable over Segre in view of Guch in further view of Kurnit in further view of U.S. Patent No. 4,858,238 by Cardimona (“Cardimona”). Cardimona is cited as disclosing a seed laser for use with a Raman shifter. As noted above, the proposed combination of Segre, Guch and Kurnit do not disclose the subject matter of Independent Claim 1. Cardimona does not disclose the subject matter lacked by Segre, Guch and Kurnit in this regard. Accordingly, Applicant respectfully submits that the proposed combination of Segre, Guch, Kurnit and Cardimona does not yield the subject matter of Claims 6 and 7, and this rejection should be withdrawn.

Claim 10 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Segre in view of Guch in further view of Kurnit and further in view of U.S. Patent No. 5,414,723 by Krapchev (“Krapchev”). Krapchev is cited as disclosing the use of a pump outside of a housing to circulate an active medium. Again, as discussed above, Segre, Guch and Kurnit do not disclose or suggest the subject matter of Independent Claim 1. Krapchev does not disclose the subject matter lacked by the proposed combination of Segre, Guch and Kurnit in this regard. Accordingly, Applicant respectfully submits that Claim 10 is patentable over the proposed combination of Segre, Guch, Kurnit, and Krapchev, and this rejection should therefore be withdrawn.

Claims 19 and 20 were rejected under 35 U.S.C. § 103 as being unpatentable over Segre in view of Guch in further view of a publication of Schwartz Electro-Optics (SEO). SEO is cited as teaching a beam steering mirror to steer a beam towards a target. As discussed above, Segre and Guch do not disclose this subject matter of Independent Claim 1. SEO does not disclose the subject matter lacked by Segre and Guch in this regard. Moreover, as noted above, Segre and Guch are directed to a ceilometer and a multiple mode laser, respectively, and neither includes any discussion of steering a beam. Accordingly, it is unclear why one would be motivated to combine the teachings of Segre, Guch and SEO as the Examiner has suggested, other than by improperly using the present disclosure as a blueprint. Applicant therefore respectfully submits that this rejection should be withdrawn.

Based upon the foregoing, Applicants believe that all pending claims are in condition for allowance and such disposition is respectfully requested. In the event that a telephone conversation

would further prosecution and/or expedite allowance, the Examiner is invited to contact the undersigned.

Respectfully submitted,

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